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IMPORTANT PROBLEMS OF RADIO ENGINEERING

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## Important Problems of Radio Engineering

(VAZHLYVI PROBLEMI RADIOTEKHNIKI )

by

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Radio Engineering is not a new science. Enormous are the values attained by it. At the outset of its development radio engineering was only a medium of communication. Gradually it conquered more and more fields of application and in our days it penetrated already into all branches of human endeavor. It is important now to name any branch of science and technology where radio engineering media are not applied in one way or another.

But radio engineering is far from being exhausted. Every day brings newer and newer achievements by this branch of science.

The press recently carried an announcement about awarding diploma No 1 to citizen scientist M.I.Kabanov for discoveries in the field of radio engineering. The nature of this discovery lies in the fact: that short waves, as is known, are reflected from the upper ionization layers of the atmosphere. In consequence such radio waves can propagate over very great distances, subsequently being reflected from the ionosphere or from the surface of the Earth.

M.I.Kabanov was the first one to describe a different mechanism of propagation of short radio waves and offered explanations to that idea. The fact is that radio waves are being reflected not only from the surface of the Earth, just like a light ray is being reflected from a mirror, but is even scattered by same just as light is scattered by a lusterless surface. A part of the radio waves is scattered in the very

same direction from whence they came. That part of scattered radio waves may return to exactly the same place from where it was emitted, following exactly the same pattern by which the radio waves arrived to the diffusion surface. What is the basis of the Kabanov effect.

The discovery by Kabanov has an important practical value, e.g. from the creation of principally new media for long distance radar (radiolocation), investigation of the ionosphere etc.

Of great interest today is the new type of communication on ultrahigh frequencies, - communication on account of the scattering of radio waves over the heterogeneities of the atmosphere. The lower atmospheric layers are heterogeneous: even in comparison to a small volume various points are distinguished by temperature, density and humidity. The ultrahigh frequency radiowaves passing on from one elementary volume of air to another, which has a different density and humidity, are scattered partially. As result of this a part of the radio waves directed in a pattern of a narrow beam at an angle relative to the surface of the Earth, returns back to Earth at great distances from the emitter. Much longer, meter radio waves, scatter over the ~~the~~ heterogeneous upper ionization layers of the atmosphere.

One of the fundamental tasks of the technology of such communication is the creation of quite powerful sources of ultrahigh frequency radio waves. These tasks are of great importance for the problem of nonconductive transmission of energy with the aid of radio waves. Soviet scientists are pioneers in the development of same.

Ideas about applying electromagnetic waves for transmission of energy over great distances have been expressed already at the dawn of development of radio engineering. However from the time O.S. Popov discovered radio - for a period of more than 50 years - further propagation of radio waves was utilized only for the

transmission of information (radio communication, radio ~~communication~~<sup>broadcasting</sup>, radio location, radio remote control, radio navigation, radio telemetering etc.).

At the half mark of the forties Soviet scientist, member correspondent of the Academy of Sciences Ukr-SSR S.I. Tetel'baum was first to present a scientific basis and outlined the fundamental steps of solving the problem of effective transmission of energy without conductors with the aid of narrowly directed beams of ultrahigh frequency radio radiation.

The system of conductorless transmission of energy has to consist of the following elements: transmitting unit consisting of powerful generators and transmitting antenna, wave channel (beam of radio waves in free space), receiver device, which consists of receiving antenna and system of converters (transformers) for the conversion of <sup>HF-</sup>energy streams into another type of energy, convenient for application, e.g. thermal energy, electric low frequency current or DC or other) and auxiliary devices which guarantees accuracy in mutual disposition of antennas, regulation of transmitted power, which should change relative to the changes in load.

Today radio engineering has attained such a level at which practical realization of conductorless transmission of energy is absolutely real, principally like already accomplished tasks.

Utilizing powerful beams of ultrahigh frequency radio waves it will be possible to apply radio waves for the destruction of rocks.

Powerful pencils of radio waves directed toward the surface of rocks will cause high rapid heating of its particles, which are not only on the surface but also at a certain depth. Such a "Thermal Impact" will bring about the appearance of cracks and the destruction of rocks. It can be expected that the treatment of rocks with the aid of radio waves will have numerous advantages over the already available methods. Other applications of beams of radio waves are connected ~~with~~

with the chemistry of highmolecular compounds - polymers. It is explained that bombardment of reagents with millimeter radio waves during the processes of producing polymers has a certain definite effect on the process of chemical reaction.

This can be explained by the fact that during the bombardment of large organic molecules with mm radiowaves they begin oscillating. The frequency of the radio waves can be selected in such a manner as to produce resonance between the frequency of the radio waves and the oscillations of the molecules. These oscillations become so intensive that there is a rearrangement (reconstruction) of atoms, of which they consist, new intramolecular bonds do form, as result there is a new synthetic material.

Radiochemistry, which originated by the junction of two sciences - radio engineering and chemistry - is making its first steps. It is still within the walls (confines) of research laboratories, but it can be expected that in the nearest future this tendency will produce new effective methods of intensifying chemical processes in the manufacture of highmolecular compounds thus leading to the obtainment of many new synthetic materials.

A majority of radio engineering trends is connected with the transmission and analysis of this or any other information. The progress in radio engineering led to the origination of a new science - theory of information, which will play a highly important role in the development of such important branches of science and technology, as cybernetics, automation of industrial processes etc.

*See page 4a for  
Illustration No. 1*

*See page 4a for  
Illustration No. 2*

Illustration left bottom: Technician Ye. L. Ivanova Assembles a Broad Band Amplifier  
Illustr. upper center: Technician V.M. Fedorets assembles an universal integrater block for ultrasonic cardiograph.



*Illustration No. 1*



*Illustration No. 2*

MCL-980/1+2

4a



The theory of Information studies the conditions of transmitting communications over this or any other communication channel. In the process of transmitting information from its source to the user there is a partial loss as consequence of distortions which are caused by the very communications channel, and also by the influence of extraneous and own impediments, which do effect the signals, which carry the information.

With the aid of the theory of information it is possible to explain by how much the distortions, which are caused by the communications channel, as well as the impediments distort the transmitted information and reduce its reliability, to outline ways of improving the quality of informations.

Kiev scientists are for many years conducting investigations on the obtainment of more thorough informations on the utilization of a certain class of devices for the transmission of information. Using optical instruments as an example it is shown in what direction these investigations are being conducted.

It is evident, that the ideas, obtained with the aid of optical instruments are inaccurately transmitted into space and so are the color characteristics of the observed objects. Image distortions depend upon many factors, especially, upon the diffraction characteristics of the optical observation system and upon the aberration (deviations) of spectral characteristics of elements of the apparatus, sometimes also upon the changes in refractivity of the atmosphere etc.

In cases, when the laws, causing the distortions, are known, the problem may be brought up of reproducing more accurate images of the object by its less accurate image, created by optical instruments. Such image "improvement" is attained by introducing into the optical system the transmission of information of certain elements which restore the information lost on account of distortions along the path between the object and image.

Work has now begun on the creation of implements, which operate by the described principle, and are intended for the obtainment of clear and voluminous x-ray images. Restoration of information, lost along the way between the source of the x-ray and the observer, as well as elimination of excessive information, which distorts the image and appears on account of the effect of layers of the object, which adhere to the layer, which is observed, is realized during the processing of x-ray pictures with the aid of the TV medical resolving device. Such devices will unavoidably promote further perfection of ~~Kinney~~ Roentgenography as well as Roentgenoscopy in Medicine and in other branches of science and technology as well.

Modern medicine is still not sufficiently equipped with devices for objective methods of examining patients. Quite often the correctness of medicinal diagnosis is determined by the experience of the doctor. The introduction of radio electronic methods into medicine will make it possible to make diagnostic investigations more accurate and eliminate subjective moments, which depends upon the individual qualities of the medical doctor (physician).

*See page 6a for  
Illustration No. 3*

Illustration column 3 (20) below: Scientific worker of the Institute L.F. Toliman-  
chuk (right) and engineer O.G. Danilenko  
are constructing a TV indicator block of  
a medical diagnostic device for automatic  
processing of x-ray pictures.

tus and are recorded with the aid of an electron-optical tube or by any other method.

The developers of diagnostic devices work on the following principle: ultrasonic pulses are sent into the examined tissues of the organism by a special irradiator of ultrasonic oscillations. As soon as irregularities in these pulses are observed along the way (between various tissues, changes in activities of tissues as result of the illness, foreign bodies) reflected pulses originate, which return into the appara-



*Illustration No. 3*

MCL-980/1+2

6a



Upper (center) illustration: Technician N. K. Saricheva together with co-worker of the Experimental Medicinal Laboratory im. October Revolution V. I. Babich assemble a device (bath) for examining tissues and human organs with the aid of ultrasonic oscillations.



Illustration (right) Engineer B. K. Gostin (right) and technician V. O. Shevchenko check a laboratory model of an apparatus for destroying stones of urinary system with the aid of electrohydraulic effect.

From the obtained images of reflected signals it is possible to determine the changes which took place in the tissues and to establish the disease, e.g. the presence of new growth (tumor).

Of great importance for diagnosing cardio-vascular illnesses can be ultrasonic devices, intended first of all for the detection of mitral stenosis and mitral deficiency. It is assumed that cardiograms obtained with the aid of such devices will offer great help to physicians, especially in instances, when the diagnosis with the aid of other methods is unreliable.

In connection with the development of cosmonautics of great importance will be the problem of cosmic radio communication. During further mastering of interplanetary space there will come requirements for increasing the range of radio communication to ranges measured in tens and hundreds of millions of kilometers and over. In this connection it will become necessary to considerably increase the capacity of transmitters and the sensitivity of receivers, and also to develop methods of increasing the accuracy of directing antenna installations, which exceed by much the available one.

For solving these highly important problems credit goes also to scientists of the Ukraine. That is why so extremely actual is the resolution of the Presidium of the Academy of Sciences Ukr-SSR to organize within the structure of the Academy a new scientific department - Institute of Radio Engineering Problems -. It will be created on the bases of radio engineering departments and laboratories of the Institute of Electrical Engineering at the Academy of Sciences Ukr-SSR.

The Plans of this scientific undertaking call for carrying out numerous investigations connected with the solving of actual problems of radio engineering, which are now confronting science. It should be expected that most effective results will be obtained there, where radio engineering is compatible with other branches of science, e.g. in the investigations of applying radio-technical methods in radio chemistry, medicine, utilization of radio waves for destruction of rocks etc.

Right now the institute is already employing a hundred people of scientific and scientific-assistant quality. In the nearest time this personnel group will be enlarged considerably, mainly on account of talented youth.

We are confident the the personnel group of our institute will in the nearest future begin contributing into the treasure of Soviet science.